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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/708,281	02/22/2004	Roman Chistyakov	ZON-016	2280

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EXAMINER	
LIE, ANGELA M	

ART UNIT	PAPER NUMBER
2821	

DATE MAILED: 05/18/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/708,281	CHISTYAKOV, ROMAN	
	Examiner	Art Unit	
	Angela M. Lie	2821	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *22 February 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-47* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-13,16-28,30,31,34-45 and 47* is/are rejected.

7)☒ Claim(s) *14,15,29,32,33 and 46* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *22 February 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date ~~2/22/2004~~, 9/13/2004, 10/14/2004, 6/16/2004, 06/01/2004
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Double Patenting

1. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970);and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

2. Claims 1-47 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-47 of copending Application No. 107088282.

This is a provisional obviousness-type double patenting rejection.

Claim Objections

3. Claim 30 is objected to because of the following informalities: quasi-steady state condition is not defined in the body of the specification. For the purpose of the examination of claim 30, an examiner considers the quasi steady state as non-constant discharge current state. Appropriate correction is required.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 1-5, 7-8, 11-13, 18-22, 24-28, 30, 34-36, 38-39, 41-45 and 47 are rejected under 35 U.S.C. 102(e) as being anticipated by Chistyakov (US 20040094411).

As to claim 1, Chistyakov discloses a plasma generator comprising: a chamber for confining a feed gas (Figure 4 element 202), an anode that is positioned inside the chamber (Figure 4 element 238), a cathode assembly that is positioned adjacent to the anode inside the chamber (Figure 4 element 216), a pulsed power supply having an output that is electrically connected between the anode and the cathode assembly (Figure 4 element 234), the pulsed power supply generating at the output a multi-stage voltage pulse (as shown in figure 6) comprising: a low-power stage including a first peak voltage having a magnitude and a rise time that is sufficient to generate a weakly-ionized plasma from the feed gas (Figure 6, stage 326 and paragraph 89), and transient stage (Figure 6 stage 338) including a second peak voltage having a magnitude and rise time that is sufficient to shift an electron energy distribution in the weakly-ionized plasma to higher energies that increase an ionization rate which results in a rapid increase in electron density and a formation of a strongly-ionized plasma (Figure 6 stages 340 and 346, even though Chistyakov does not explicitly state that the second

voltage produces fully ionized plasma from the weakly-ionized plasma, it can be seen from the figure 6, that the second applied voltage has to be sufficient to produce fully ionized plasma because stage 346 is fully ionized).

As to claim 2, Chistyakov discloses the plasma generator comprising a magnet that generated a magnetic field proximate to the cathode assembly (Figure 4, element 256).

As to claim 3, Chistyakov discloses the plasma generator wherein the magnet is movable (Figure 4 element 256, since elements 256 and 216 are separate structures, magnet (256) is capable of being moved away from element 216).

As to claim 4, Kozunetsov discloses the plasma generator whrein the magnetic field generated by the magnet confines the weakly-ionized and strongly ionized plasmas proximate to the cathode assembly (paragraph 30).

As to claim 8, Chistyakov discloses the plasma generator wherein the pulsed power supply (Figure 4 element 234) provides enough energy for the electron energy distribution in the weakly-ionized plasma to continuously shift to higher energies until the strongly ionized plasma is formed (as shown in figure 6, there is the transition from weakly-ionized plasma (stage 326) to fully ionized plasma (stage 346) therefore it is inherent that pulsed power supply provides enough energy for electron energy distribution to reach strongly ionized plasma, furthermore the main purpose of a plasma generator is to produce strongly ionized plasma therefore it would be pointless to have power supply which would produce insufficient amount of energy to produce strongly ionized plasma).

As to claim 11, Chistyakov discloses the plasma generator wherein the pulsed power supply generates the transient stage (Figure 6 stage 338) of the multi-stage pulse at a time that is at least 150 .mu. seconds after the generation of the weakly-ionized plasma (Figure 6, interval from t1 to t2, paragraphs 79 and 91).

As to claim 18, Chistyakov discloses the plasma generator wherein the multi-stage voltage pulse as shown in figure 6) further comprises a high-power stage (Figure 6, stage 346) following the transient stage (Figure 6, stage 338), the high-power stage having a voltage that is sufficient to sustain the strongly-ionized plasma (the voltage supplied is sufficient to sustain strongly-ionized plasma for a the time interval from t5 to t6).

As to claim 19, Chistyakov discloses the plasma generator wherein the voltage in the high-power stage comprises a relatively constant average voltage (Figure 6 stage 346).

As to claim 21, Chistyakov discloses a method of generating a strongly-ionized plasma comprising: supply feed gas proximate to an anode and cathode assembly (Figure 11A, element 608), generating weakly-ionized plasma by applying a first voltage between the anode and the cathode assembly, the first voltage having a magnitude and a rise time that is sufficient to ignite the feed gas (Figure 11A, element 618); and generating a strongly-ionized plasma by applying a second voltage between the anode and the cathode assembly, the second voltage having a magnitude and a rise time that is sufficient to shift an electron energy distribution in the weakly-ionized plasma to

higher energies that increase an ionization rate which results in a rapid increase in electron density and a formation of strongly-ionized plasma (Figure 11B, element 622).

As to claims 22 and 39, Chistyakov discloses the method comprising applying a magnetic field proximate to the cathode assembly (Figure 11A, element 614).

As to claim 25, Chistyakov discloses the method wherein the first and the second voltages comprise a multi-stage voltage pulse (as shown in figure 6).

As to claim 26, Chistyakov discloses the method further comprising applying a third voltage between the anode and the cathode assembly that sustains the strongly ionized plasma (Figure 6, stage 346, time interval from t5 to t6, voltage inherently has to be applied between anode and cathode because this is where the plasma is contained).

As to claim 27, Chistyakov discloses the method wherein an average value of the third voltage applied between the anode and the cathode assembly is relatively constant (Figure 6 stage 346).

As to claims 20 and 28, Chistyakov discloses the plasma generator wherein a lifetime of the strongly-ionized plasma is greater than about 200 .mu.seconds (paragraph 114).

As to claim 30, Chistyakov discloses the method wherein the weakly-ionized plasma is in a quasi-steady state condition before the application of the second voltage (paragraph 62, where the quasi-steady state condition corresponds to non-constant discharge current state).

As to claims 12 and 35, Chistyakov discloses the plasma generator wherein the rise time of the second peak voltage in the transient stage is greater than about 0.5

V/.mu.seconds (Figure 6, interval from t2 to t3, the slope of this line can falls in the range of being greater than about 0.5 V/.mu.seconds because the voltage supplied in this stage is in the range of 200 V - 30KV and time range is 0.1 .mu.second – 10 seconds, in regard to claim 35, voltage is inherently applied between anode and cathode because this is the area where the plasma is contained).

As to claim 38, Chistyakov discloses a method of generating strongly-ionized plasma comprising: a supplying feed gas proximate to an anode and a cathode assembly (Figure 11A, element 608); and applying a voltage pulse between the anode and the cathode assembly (paragraph 147, 3 last lines of this paragraph), the pulse comprising a first peak voltage having a magnitude and a rise time that is sufficient to ignite an initial plasma from the feed gas (Figure 6, stage 326), and a second peak voltage having a magnitude and a rise time that is sufficient to shift an electron energy distribution in the initial plasma to higher energies that increase an ionization rate resulting in a rapid increase in electron density and formation of the strongly-ionized plasma (Figure 6 stage 338) that is sustained for greater than 200 .mu. seconds (paragraph 114).

As to claims 5, 24 and 41, Chistyakov discloses the plasma generator wherein the magnetic field generated by the magnet (Figure 4 element 254) and an electric field generated by the multi-stage voltage pulse (Figure 4 element 234) induces an Hall current that raises the temperature of the electrons in the weakly-ionized plasma to a temperature that enhances the rapid increase in electron density and the formation of the strongly-ionized plasma (crossing of magnetic and electric field will inherently

produce the Hall effect i.e. E field is perpendicular to the current flow and E field is also perpendicular to the magnetic field, flow of current inherently raises the temperature of electrons and in result electrons have more energy so they are more vulnerable to move to the ionized state. In other words Hall current will support the transition from weakly to strongly ionized plasma as to obey the laws of physics).

As to claim 42, Chistyakov discloses the method wherein the voltage pulse further comprises a substantially constant voltage that sustains the strongly-ionized plasma (Figure 6, element 346, interval from t5 to t6).

As to claim 43, Chistyakov discloses the method wherein duration of the voltage pulse is greater than 200 .mu. seconds (paragraph 114, the time interval from t5 to t6 is between 1.mu.second to 10 seconds therefore the range of greater than 200 .mu. seconds is contained in the time range taught by Chistyakov).

As to claims 7, 34 and 44, Chistyakov discloses the plasma generator wherein the magnitude of the first peak voltage is less than 1000 V (Figure 6, stage 326, where 100V falls in the range of less than 1000V).

As to claims 13, 36 and 45, Chistynakov discloses the plasma generator wherein the magnitude of the second peak voltage is less than about 1000 V over the first peak voltage (Figure 6 interval from t2 to t3, as shown on the voltage axis in figure 6 the range less than about 1000 V is covered by the range disclosed by Chistynakov, because weakly-ionized plasma has voltage range 100 V- 5KV and the second peak voltage can be in range of 200V to 30kV).

As to claim 47, Chistyakov discloses an apparatus for generating a strongly-ionized plasma, comprising means for supplying feed gas proximate to an anode and a cathode assembly (Figure 4, element 208), means for generating a weakly-ionized plasma from the feed gas (Figure 4, elements 256 and 234), means for shifting an electron energy distribution in the weakly-ionized plasma to higher energies that increase an ionization rate which results in a rapid increase in electron density and a formation of the strongly-ionized plasma from the weakly-ionized plasma (Figure 4, elements 256 and 234); and means for sustaining the strongly-ionized plasma for greater than 200 .mu. seconds (Figure 4 elements 256 and 234, and paragraph 114).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chistyakov (US 20040094411) in the view of Chistyakov (US 20040222745). Chistyakov (US 20040094411) discloses all the limitations presented in claim 1, he does not teach however that the feed gas comprises at least one of excited and metastable atoms. Chistyakov (US 20040222745) teaches the excited atom source generating exciting atoms including metastable atoms from the ground state atoms and provides the excited atoms including the metastable atoms to the chamber (paragraph

37). It would have been obvious to one of the ordinary skill in the art during the time when the invention was made to have feed gas comprising of at least one of excited and metastable atoms because metastable atoms require less energy to ionize than a similar volume of ground state atoms, the metastable atoms ionize at higher rate than ground state atoms for same input energy (US 20040222745, paragraph 45).

8. Claims 9 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chistyakov (US 20040094411) in the view of Kozunetsov (US 6296742). Chistyakov discloses all the limitations presented in claim 1, however he does not teach that the plasma generator comprises an energy storage device that is electrically coupled to the cathode assembly, the energy storage device discharging energy into the weakly-ionized plasma to enhance the rapid increase in electron density and the formation of strongly-ionized plasma. Kozunetsov teaches storage device electrically coupled with the cathode assembly (Figure 6 element C1), which ultimately enhances the rapid increase in electron density and a formation of the strongly-ionized plasma (column 10 lines 29-37). It would have been obvious to one of the ordinary skill in the art during the time when the invention was made to incorporate Kozunetsov storage device into Chistyakov's plasma generator because storage device when discharging allows for output voltage to rise very fast and this could speed up the time of formation of fully ionized plasma (column 10 31-32).

9. Claims 10, 16 and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chistyakov (US 20040094411).

As to claims 10 and 37, Chistyakov teaches that weakly-ionized plasma has discharge voltage on the order of 100V-1000V and discharge current on the order of 0.1 A – 10A (paragraphs 60 and 62), this in result can give the discharge power of 10W – 10000W. It would be obvious to one skilled in the art during the time when the invention was made that the weakly-ionized plasma has a discharge current density that is less than about 0.5A/cm^2 and a power density that is less than about 250W/cm^2, because the ranges of discharge current and power densities as described by Chistyakov once divided by the area (typical for plasma generators) will cover the ranges less than 0.5A/cm^2 for current density and less than 250W/cm^2 for power density.

As to claim 16, Chiostyakov teaches that strongly-ionized plasma has discharge current on the order of 1000 A and more and discharge voltage in the range of 50V-1000V (paragraph 84). It would have been obvious to one of the ordinary skill in the art during the time when the invention was made, that discharge current density of the strongly-ionized plasma is greater than about 0.5 A/cm^2 because once the discharge current of the order of 1000A or more is divided by the area typical for plasma generators, it will result in the number that is larger than 0.5 A/cm^2.

As to claim 17, Chiostyakov teaches that strongly-ionized plasma has discharge current on the order of 1000 A and more and discharge voltage in the range of 50V-1000V (paragraph 84). This will in result will provide the discharge power on the order of at least 50 KW therefore it would have been obvious to one of the ordinary skill in the art during the time when the invention was made, that the power density of the strongly-ionized plasma is greater than 250 W/cm^2, because once the 50 KW or more is

divided by the area typical for plasma generators, it will result in the power density larger than 250 W/cm^2.

10. Claims 23 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chistyakov (US 20040094411) in the view of Wang et al (US 6413382). Chistyakov discloses all the limitations presented in claims 22 and 39,however he does not teach the method comprising moving magnetic field. Wang et al teach a method which involves a magnetron which can be rotated about the center (column 1 lines 64-66). It would have been obvious to one of the ordinary skill in the art during the time when the invention was made to incorporate Wang et al step, which requires rotating a magnetron into Chistyakov's plasma generator because rotating a magnetron around the center provides more uniform sputtering and deposition (column 1 lines 64-66).

11. Claims 14-15, 29, 32-33 and 46 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Allowable Subject Matter

12. As to claim 14, the prior art failed to teach the plasma generator wherein the second peak voltage in the transient stage forms ionizational instabilities in the weakly-ionized plasma. This limitation is clearly disclosed in claim 14.

As to claim 15, the prior art failed to teach the plasma generator wherein the transient stage generates diocotron oscillations in the weakly ionized plasma. This limitation was clearly specified in claim 15.

As to claim 29, the prior art failed to teach the method wherein the weakly-ionized plasma is in a steady state condition before the application of the second voltage. This limitation is clearly stated in claim 29.

As to claims 32 and 46, the prior art failed to teach the method wherein the rise time of the second voltage are sufficient to generate ionizational instabilities in the weakly-ionized plasma that enhance the ionization rate resulting in a rapid increase in electron density and the formation of the strongly-ionized plasma. This limitation is clearly stated in claims 32 and 46.

As to claim 33, the prior art failed to teach the method wherein the ionizational instabilities comprise diocotron instabilities, as clearly stated in claim 33.

The Prior Art

13. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

- US 20040082187 discloses high power pulsed magnetically enhanced plasma processing
- US 6254745 discloses ionized physical vapor deposition method and apparatus with magnetic bucket and concentric plasma and material source
- US 6197165 discloses the method and apparatus for ionized physical vapor deposition.

Conclusion

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Angela M. Lie whose telephone number is 571-272-8445. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Don Wong can be reached on 571-272-1834. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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